4,1,3 (22A) I1-034

IMPROVING WATER QUALITY THROUGH WET CORRIDOR RESTORATION:
Cosumnes River Preserve Water Quality Monitoring Program.

Applicant: Department of Fish and Game Water Quality Laboratory, at Moss Landing Marine Laboratories, & the Watershed Institute, California State University Monterey Bay.
Project Description: The Nature Conservancy's Cosumnes River Project is one of the best watershed restoration programs in the state. It is successfully recovering water and related ecosystem services as it restores CALFED priority habitat and species- all part of our endangered freshwater ecosystem. The restoration of wet corridors is the most important action we can take to improve water quality throughout the state, and particularly along the drainages into the Bay-Delta system. Naturally vegetated rivers, creeks, and marshes are one of the best water pollution filters known. Wetland vegetation and associated habitat combine to create a thick ecological sponge which physically filters sediment and organic-mineral aggregates from surface water. The high surface areas of these small, complex particles are active binding sites for many of the chemical contaminants from the watershed. This biologically active filter also captures and degrades chemical contaminants. Microorganisms live on plant surfaces and especially on and in the sediment. These biochemical factories capture, degrade, and recycle many chemicals. For example, nutrients such as nitrogen are used directly by the living plants. The overall result is considerable improvement to water quality.

The Cosumnes River project area is impacted by many farm drainages that can be filtered through water management areas; and is located along a watershed gradient of water quality with tidal inputs from the Delta. Since it is the only major river in the valley without a dam, the transport of metals from this watershed may be unique to the Bay-Delta system.

The Cosumnes River project has initiated a number of realistic restoration projects that will enhance ecosystem services, especially developing water management systems that improve water quality. The projects are fundamentally experiments that can be tracked to determine how water quality improves under varying land use treatments. One land use treatment in progress is the expansion of the channelized river by opening dikes in locations where the river historically flowed, creating ecologically engineered secondary dikes that define a more natural river area and protect adjacent land use. The colonizing wetland filter will remove garbage, suspended sediments, nutrients, and other chemical contaminants from water. Another land treatment develops wetland farming within the low flood plain next to the expanded river- for rice production, wildlife habitat, and improved water quality. The inflow water to the rice fields is normal brown: the outflow is clear. Other treatments include construction of wetlands along irrigation ditches, and water management areas for roosting and nesting waterfowl.

We propose a water quality monitoring program aimed primarily at assessing the success of restoration efforts at improving water quality along the Cosumnes River. The experiments are in progress, and more are planned. We have already developed and initiated a similar water quality monitoring program in the Monterey Bay area, again targeting the success of wet corridor restoration. The Cosumnes River project is a magnificent water quality experiment, with many clear signs of success. This should be documented and presented to the widest possible audience (see complementary Inquiry from the SIVA Center and Watershed Institute, CSUMB).
Approach/Tasks/Schedule: The Cosumnes experiments are important to document because they concern the best management practices to improve water quality; they are realistic because of the large spatial scale; and they are well designed because of control sites that are also available as well as replication of large experimental units (e.g., rice fields, recovering wet corridors, waterfowl ponds, and irrigation ditches). Water quality monitoring stations will be located where water first flows into restored wet corridors or other water management areas, within the system, and at outflow sites to document changes in water quality (see attachments). Sampling locations, times, and target measurements will be integrated into existing water quality monitoring programs up and

down the river, primarily the regional monitoring program. However, most of the monitoring will be done within the preserve associated with its large-scale experimental restoration areas. The number of stations, site replication, experimental design replication, timing, and target measurements will be developed for each experimental opportunity. In general, water quality will be monitored in a step-protocol (developed and tested in Monterey Bay with EPA and SWQCB support), i.e., proceeding to the next step of assessment if the data from the first measures indicate degraded water quality. Sediment and nitrate in water will be used as a general indicator of drainage inputs, particularly from farm, dairy, and grazing land. These inputs will be monitored at peak rainfall and at key seasons at inflows and outflows from the restored wet corridors, other experimental sites, and reference or control areas. If high nutrients and/or suspended sediments are present or other information suggests a significant water quality problem, then a stepwise monitoring will be done for pesticides, herbicides, and other contaminants by first sampling the tissues of freshwater clams (*Corbicula* is commonly used in California-see attached table), then in sediments from depositional sinks, and then in the tissues of indicator native species. In the event of extremely poor water quality conditions, we will conduct a series of realistic bioassays to target the primary chemical contaminant. Bioassays have not been required in our previous restoration monitoring. Changes in water quality can also be photographed, patterns can be quantified from these images, and the pictures and data disseminated to a target audience, for example using a multi-layered computer map (see the Inquiry proposal from the SIVA Center and Watershed Institute, CSUMB).

Justification for Project and Funding by CALFED: The Cosumnes River project is one of the best examples of river restoration and water resource enhancement in the state. The impacts on water quality are highly positive and essential for water reuse. The success of the project should be assessed through a water quality monitoring program that can lead directly to accurate estimates of the total mass of pollutants removed per acre of habitat under different restoration treatments. The experiments in progress at the Cosumnes River Preserve already involve a broad range of water quality enhancement practices that are ecologically sound, sustainable, and economically critical to the future of water reuse. In addition to significant water quality improvement, the wetland sponge is critical for surface water retention, ground water recharge, flood protection, and biodiversity. Along with water quality improvement, these are the major water resource values essential to a sustainable watershed for the present and growing human population. Results of our analyses are likely to show that restoration is a very low-cost solution to poor water quality and provides the highest, sustainable return in water resources and their ecosystem services.

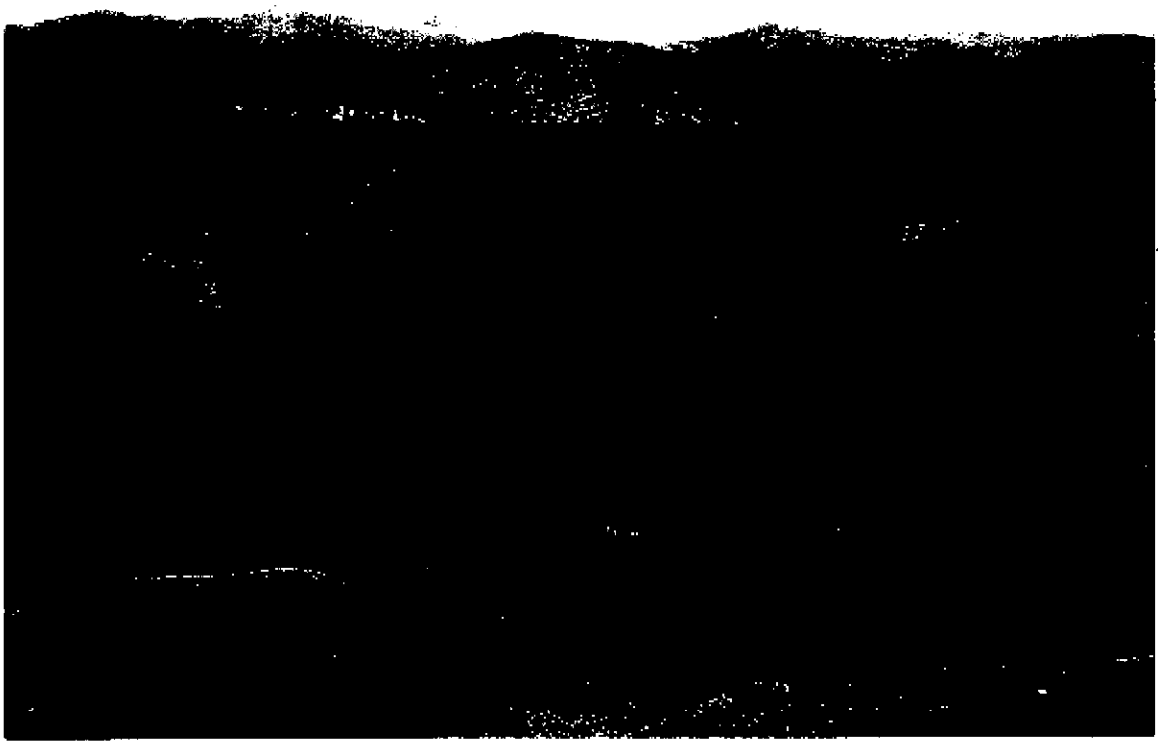
Budget Costs: The direct costs of the proposal are $180,000, the indirect costs are $45,000 (25%), and the total is $225,000.

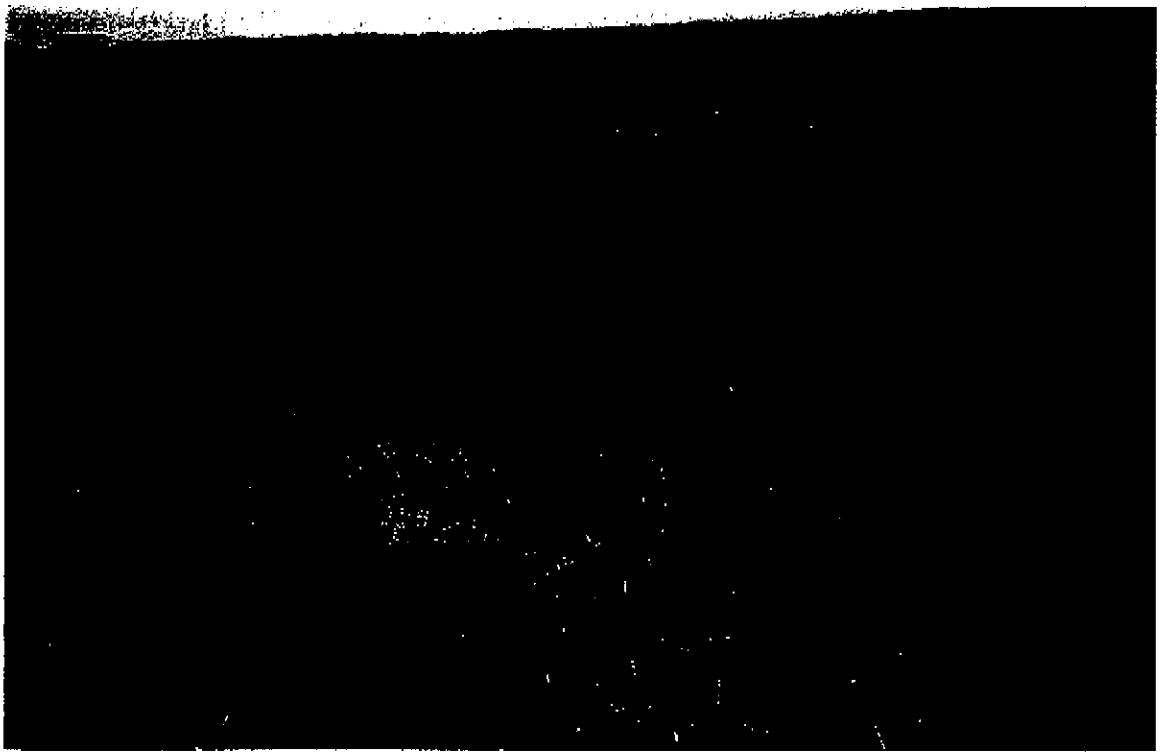
Investigators: The principal investigators are Mark Stephenson, the Director of the Fish and Game Water Quality Laboratory, Eden Rue, Professor of Water Chemistry at the Earth System Science and Policy Institute at CSUMB, John Oliver, Adjunct Professor of Ecology at Moss Landing Marine Laboratories and Restoration Coordinator at the Watershed Institute, and Rich Reiner from TNC Cosumnes River Preserve. The Monterey group developed and implemented the water quality monitoring programs for the wet corridor restorations of the Watershed Institute, with support from DoD, EPA, Regional and State Water Boards.

Monitoring and Data Evaluation: This proposal is possible because the Cosumnes River project is already implemented and successful; it needs to be monitored to assess and report success in a variety of private and public forums. We will use research protocols for monitoring and evaluating success used by us and approved by EPA and SWQCB.

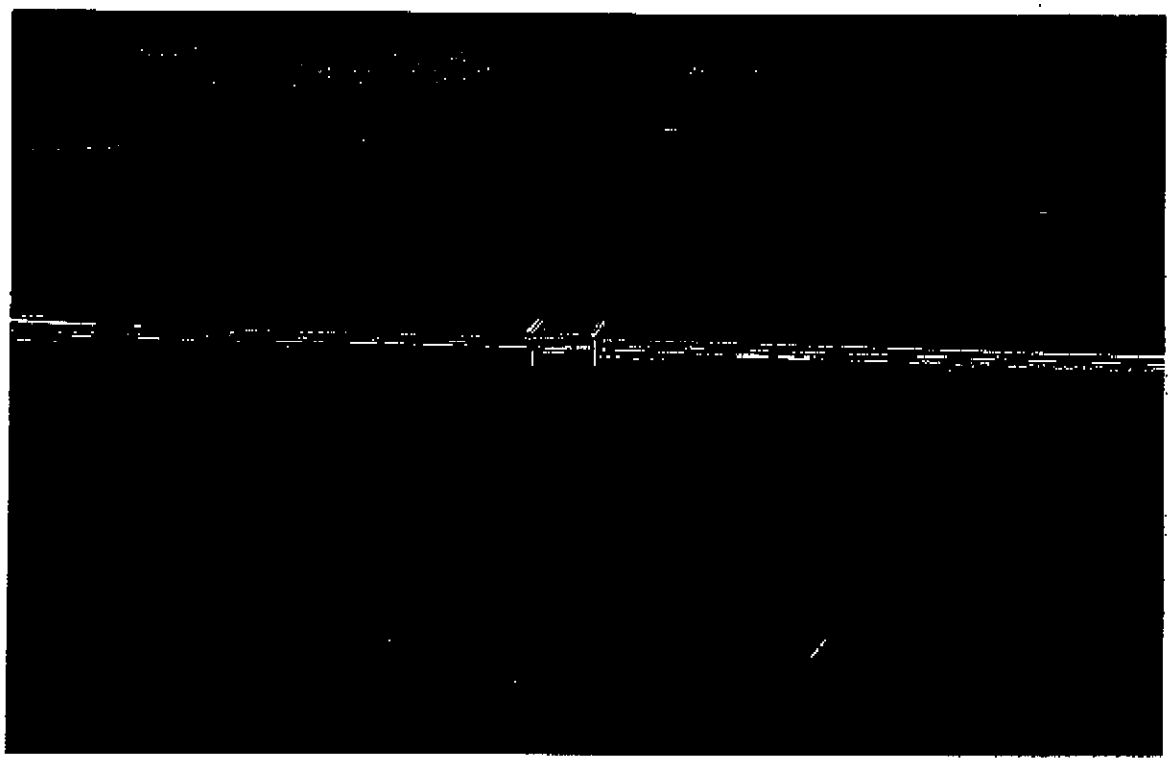
Coordination with Other Programs/Compatibility with CALFED Objectives: The proposed water quality monitoring is an excellent examples of realizing important CALFED objectives, and can be well coordinated with local, state and federal groups-including regional monitoring using macroinvertebrate indicators of water quality.

Examples of natural wetland filters restored into a formerly unvegetated ditch along Natividad Creek. Water quality improved significantly.

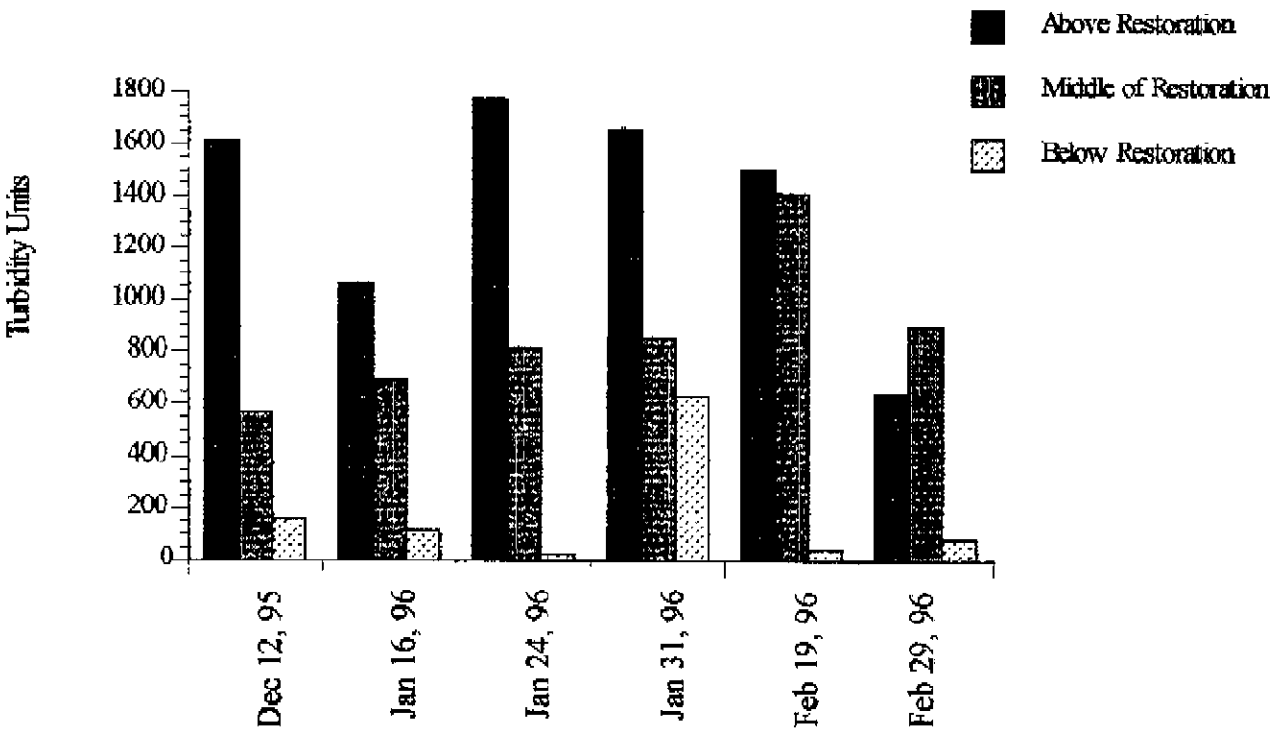




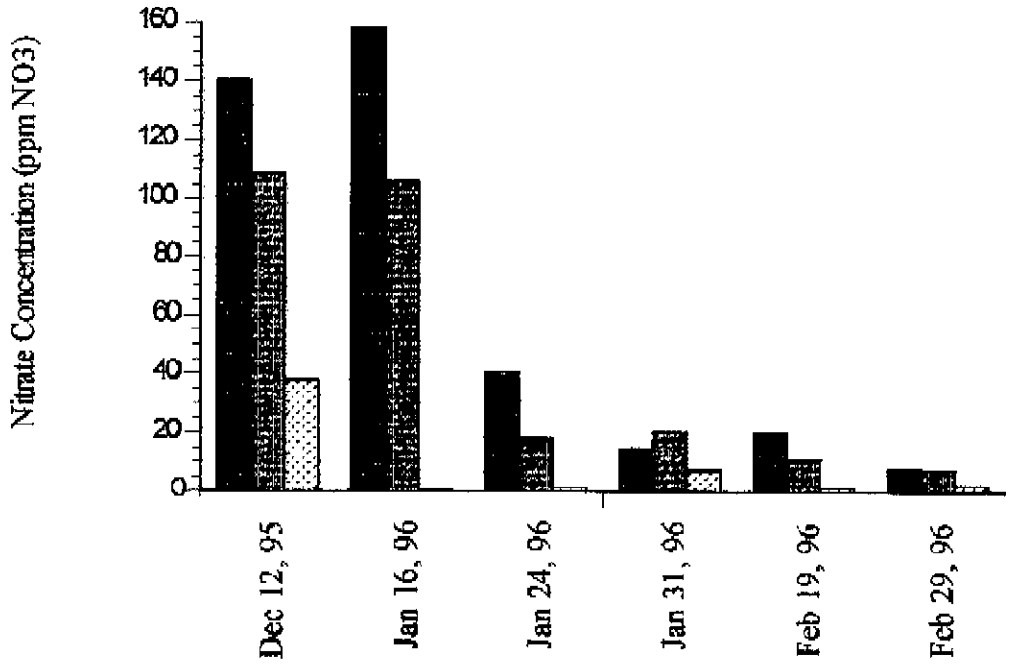
Restored wetlands created by excluding cattle and blocking drainage ditches now clean runoff water from Moon Glow Dairy along Elkhorn Slough.



Hansen Turbidity Measurements



Hansen Nitrate Concentrations



Turbidity and nitrate measurements at three sites through the drainage of Hansen Slough Restoration project during the winter rain events of 1995-1996.

Pesticide Removal in Ongoing Wetland Restorations

Pesticides in clam tissue (ng/g) exposed for a month at the water inflow and outflow areas of Hansen Slough and Natividad Creek- wet corridor restorations in the Monterey Bay area. The most abundant pesticides are removed by the developing wetland filter, with the major exception of persistent, high DDT in lower Hansen Slough.

Natividad Creek Pesticides

Pesticide	**Water Inflow**	**Water Outflow**
total DDT	4007	1447
toxaphene	3140	2340

Hansen Slough Pesticides

Pesticide	**Water Inflow**	**Water Outflow**
total DDT	124	4042**
Dacthal	3370	689
Chloropyrifos	712	179

** historically concentrated in a major wetland sink.

I-007552